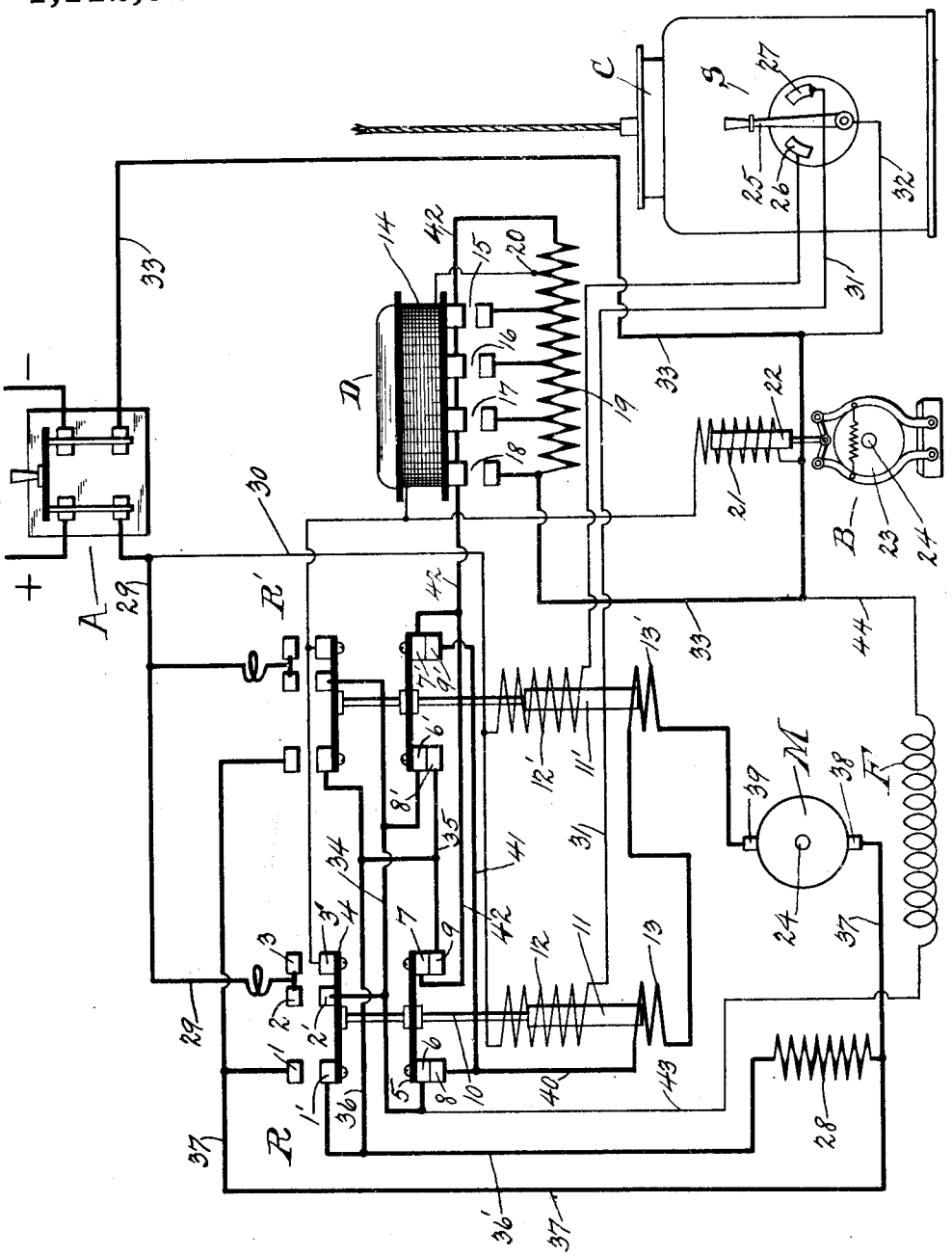
W. D. LUTZ.

SYSTEM OF MOTOR CONTROL.

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Witnesses:

Walter C. Strang

Ernest L. Gale Jr.

Inventor:

William D. Lutz

By L H Campbell

Attorney

UNITED STATES PATENT OFFICE.

WILLIAM D. LUTZ, OF ALLENDALE, NEW JERSEY, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

SYSTEM OF MOTOR CONTROL.

1,112,925. Specification of Letters Patent. Patented Oct. 6, 1914.

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To all whom it may concern:

Be it known that I, WILLIAM D. LUTZ, a citizen of the United States, residing in the borough of Allendale, in the county of Bergen and State of New Jersey, have invented a new and useful Improvement in Systems of Motor Control, of which the following is a specification.

My invention relates to improvements in motor controlling systems, and has for one of its objects the provision of simple and efficient means for preventing a too sudden reversal of an electric motor.

A further object is the provision of means for preventing destructive arcing at the contacts of the controlling switches.

Other objects will appear hereinafter, the novel combinations of elements being pointed out in the appended claims.

The drawing accompanying this specification represents diagrammatically a system of motor control embodying my invention.

Referring to this drawing, A designates a main line switch by means of which the system of wiring is connected to a suitable source of current supply designated by the conductors + and —.

R and R′ designate motor starting and reversing switches, while M is the armature of an electric motor.

F designates the motor field, and in the present instance is shown as a simple shunt winding, although my invention is not limited to shunt wound motors or motors of any particular type or winding.

28 is the stopping resistance whose function is to provide a path of comparatively low resistance for the current generated by the motor when the same is being brought to rest.

19 designates the motor starting resistance which is included in the armature circuit of the motor upon starting and is automatically removed from, or cut out of, said circuit as the motor accelerates. The automatic means for controlling the starting resistance 19 consists of an accelerating magnet D which effects the closure of a plurality of contacts 15, 16, 17 and 18 in successive order or sequence, these contacts being connected to the resistance at suitable points thereon.

B designates the usual spring pressed electrically released brake mechanism, which operates to retard the rotation of a brake or friction pulley 23 secured to the motor shaft 24.

C designates a suspended elevator car which may be operatively connected to the motor M after the usual manner.

S is a switch in the car by means of which the motor may be started, stopped, and reversed in a manner to be pointed out hereinafter.

Having given a brief description of the various parts used in carrying out my invention, I will now describe in detail certain of the more important parts, at the same time tracing the circuits so that a clear understanding may be had of the operation of the system as a whole.

The reversing switches R and R′ are similar in construction. The switch R for example, comprises a solenoid core 11 to which is connected a rod 10. Fastened to this rod 10 are two insulated pieces 4 and 5 to which are secured contacts 1′, 2′, 3′ and 6, 7 respectively. Directly below the contacts 6 and 7 are stationary contacts 8 and 9 which are normally in electrical engagement with the contacts 6 and 7, respectively. Other stationary contacts 1, 2 and 3, are located directly above the contacts 1′, 2′ and 3′, respectively, and under certain conditions are placed in electrical engagement therewith, that is when the core 11 and connected parts are in their raised position. Surrounding the core 11 are two magnet windings 12 and 13, the winding 12 being adapted to raise the core 11 and connected parts when energized, while the winding 13 under certain conditions tends to pull the core 11 downwardly. Assume the main line switch A closed, and the various parts in the position shown. In order to start the motor to raise or lower the elevator car C, the operator effects the energization of one or the other of the reversing switches, R and R′, by moving the lever 25 of the switch S to the right or left. We will assume that this lever has been moved to the right until it engages the stationary contact 27. A circuit is thereby closed to the magnet winding 12 of the reversing switch R, this circuit being traced as follows: from the + positive main, through switch A, wire 30, to and through the magnet 12, wire 31, contact 27 of the switch S, lever 25, wire 32, and by the wire 33 and switch A to the — negative main. The winding 12 is thus energized to

raise the core 11 and connected parts, thereby causing the contacts 1′, 2′, 3′, to engage the contacts 1, 2, 3, respectively, and at substantially the same time separating the contacts 6 and 8, and the contacts 7 and 9, respectively. This operation closes circuits to the motor armature and field which may be traced as follows: from the positive main + by way of the conductor 29, contacts 2 and 2′, wire 34, contacts 6′ and 8′, wires 35 and 36 to the contacts 1′ and 1, wire 37, armature brush 38, motor armature M, brush 39, windings 13′ and 13, wires 40 and 41, contacts 9′ and 7′, wire 42, to and through the starting resistance 19, and by way of wire 33 to the — negative side of the line. The shunt field circuit may be traced from the main 29, contacts 2 and 2′, to and through the shunt field F by way of the wires 34 and 43, and by wires 44 and 33 to the — line. The motor now receives current and starts to rotate at slow speed, its current being limited by the starting resistance 19. The winding of the accelerating magnet D being connected across a circuit including the motor armature and a small portion of the starting resistance, will be subjected to the counter-electro-motive force of the rotating armature. As the motor accelerates in speed the magnet D will automatically operate successively to close the contacts 15, 16, 17 and 18, controlled thereby in successive order, and in this manner the starting resistance 19 will be short-circuited step by step and the motor will gradually attain full running speed. The magnet of the brake B had its circuit closed at the contacts 3, 3′ of the reversing switch R simultaneously with that of the motor, hence the brake was released at the same time that the motor received current and started to rotate. If the operator had moved the switch lever 25 to the left, the operation would have been similar, but in this case the magnet 12′ would have been energized instead of the magnet 12, and the reversing switch R′ controlled thereby would close the circuits in such a way as to cause the motor armature to rotate in the opposite direction.

In order to stop the motor, the switch lever 25 in the elevator car is brought back to its original position, thereby open-circuiting the winding 12 of the reversing switch R at the contact 27. The winding 12 is now deënergized and allows the solenoid core 11 to drop back to its original position, thereby causing the contacts 1′, 2′, 3′ to move out of electrical engagement with the contacts 1, 2, 3, respectively, thus opening the circuits of the motor, accelerating magnet, brake magnet and shunt field. At substantially the same time the contacts 6 and 7 come into electrical engagement with the contacts 8 and 9, respectively, and by so doing they close a local, or dynamic brake circuit, including the motor armature, windings 13 and 13′, and the stopping resistance 28. This dynamic brake circuit may be traced as follows: from the armature brush 38, to and through the stopping resistance 28, wires 36′, 36 and 35 to the contacts 9 and 8′. At these contacts the circuit divides, one branch going by way of the contacts 9 and 7, wire 42, contacts 7′ and 9′, wire 41 to the wire 40, the other branch going by way of the contacts 8′ and 6′, wire 34, contacts 6 and 8 to the wire 40. From the wire 40 the circuit continues through the coils 13 and 13′ and so to the armature brush 39. By following the circuit just traced, it is seen that the current generated by the motor passes through both of the windings 13 and 13′ and the amount of this current will depend upon the resistance of this local or dynamic brake circuit, as well as the electro-motive force of the motor, which latter depends upon the speed of the rotating armature. In most cases the residual magnetism of the motor field is all that is necessary to cause a sufficiently high potential to be generated in order that the dynamic braking effect may be ample to effect the desired result. If desired the shunt field circuit may be maintained unbroken at all times, or the current in the shunt maintained unbroken at all times, or any suitable means may be employed to maintain the desired field strength.

In a motor controlling system where it becomes necessary to reverse the motor from time to time, a good example of which may be found in an electric elevator installation, it frequently happens that a careless operator will attempt to reverse the motor when the same is running at full or slightly reduced speed, which operation will always result in flashing and burning of the contacts as well as drawing a heavy overload current from the mains, and at the same time subjecting the motor and mechanically connected parts to a severe strain, which may under some conditions prove disastrous. As before pointed out, one of the principal objects of my invention is to prevent this sudden reversal of the motor and thus eliminate all danger of injury to the motor itself or other parts associated therewith, as well as to prevent arcing or burning at the contacts.

Referring again to the drawing, it is seen that as soon as the operator attempts to suddenly reverse the motor by moving the switch lever 25 out of engagement with the contact 27, the magnet of reversing switch R immediately becomes deënergized, and the switch drops back to its initial position with the contacts 6 and 7, and 8 and 9, respectively, in electrical engagement. As before pointed out, this operation closes a dynamic brake circuit including the windings 13 and 13′ and the stopping resistance 28. Since

both of the cores 11 and 11′ are at this time in their lowermost position, the dynamic brake current flowing through the windings 13 and 13′ will exert a powerful downward pull upon the cores 11 and 11′, respectively. As the operator in his endeavor to suddenly reverse the motor, now moves the switch lever 25 into electrical engagement with the contact 26, thereby completing a circuit to the magnet winding 12′ of the reversing switch R′, the latter will be unable to operate, and close a circuit from the main line to the motor, since the downward pull upon the core 11′ of this switch effected by the current in the coil 13′ is sufficient to overcome the pull of the winding 12′ in the opposite direction. Thus it is readily seen that as long as the reversing switches are in their downward position and the motor armature has any considerable rate of rotation the latter will generate sufficient current to cause the windings 13 and 13′ to hold their respective reversing switches R and R′ in their lowermost position. As the motor slows down and the dynamic brake current generated by the rotating armature becomes less and less, the magnetizing power of the windings 13 and 13′ becomes reduced to such an amount that either one of the reversing switches R or R may be raised to start the motor in the same or a reverse direction as desired. Since the dynamic brake circuit is only established upon stopping or reversing the motor, and since this circuit includes the lower contacts of the reversing switches, it follows that all heavy arcing and burning at these contacts is avoided, because neither of the reversing switches can be raised to interrupt this heavy stopping current until the latter has been greatly reduced.

The windings 13 and 13′ are included in the starting circuit as well as the stopping or dynamic brake circuit, but it will be observed that the starting current does not flow therethrough until after one of the reversing switches such as R has been raised by the solenoid winding 12. Since the core 11 is at such time raised out of the magnetic influence of the winding 13, any current flowing in the latter will have substantially no effect upon the switch R. The switch R′, however, will at this time be in its lowermost position with its core 11′ in such position with respect to the winding 13′ that the latter will be enabled to exert its maximum downward pull upon the core 11, thereby holding the contacts 6′, 8′ and 7′, 9′ respectively in firm electrical contact with each other.

It will be seen that the dynamic brake circuit includes the lower or series windings 13, 13′ of the reversing switches, also the lower contacts of both switches, hence it follows that the circuit cannot be broken at the reversing switch contacts until its current flow has been substantially reduced in amount. This feature is of great practical importance since it effectually prevents destructive arcing at the reversing switch contacts and also insures that the dynamic brake circuit will remain unbroken until the motor has either come to rest or slowed down considerably. Furthermore, this feature not only makes it impossible for the operator to suddenly reverse the motor, but also prevents him from opening the motor circuit and again closing the same by means of either reversing switch when the motor is not in condition to be connected to the main line.

When it is desired to use the resistance 28 across the armature so as to dissipate the energy of the motor in stopping and thus place a load upon the motor, the resistance of the windings is preferably made as low as possible. In case the resistance 28 is dispensed with, it would be advisable to make these windings 13 and 13′ of an appreciable resistance, so that the armature short circuit upon stopping would not be too severe.

From the foregoing it will appear that by the combination of circuits and the various parts controlling them which I have shown, that if the operator has started the motor running in either direction, and has then tried to stop or reverse it, he cannot again close a circuit through the motor from the main line until its armature has either come to rest or slowed down considerably. It will therefore be impossible for him to injure the motor by reversing it suddenly, as he might otherwise do without the apparatus herein described.

What I claim as new and desire to have protected by Letters Patent of the United States, is:—

1. The combination of an electric motor, controlling mechanism therefor comprising reversing switches, magnet coils controlling said switches and in circuit with the motor armature when the latter is connected to receive current from the mains, and means for establishing a circuit through said coils when the reversing switches are open.

2. The combination of an electric motor, reversing switches therefor, and electromagnetic devices each permanently connected in series with each other and the motor, said devices controlling said switches.

3. The combination of an electric motor, reversing switches therefor, electromagnetic means connected in the circuits established through the motor armature when the reversing switches are closed, and means associated with the reversing switches for establishing a local circuit through the armature and said electromagnetic means when the reversing switches are both open.

4. The combination of an electric motor, reversing switches, reversing switch magnets and opposing electromagnets perma-

nently connected in the circuits established through the motor armature when the reversing switches are closed.

5. The combination of an electric motor, a reversing switch, an electromagnet comprising a solenoid and a core for operating the said switch, and an opposing magnet coil in position to control the said core only when the reversing switch is open, said opposing coil being connected in circuit with the motor armature and receiving the current flow through the armature independently of the position of the reversing switch.

6. The combination of an electric motor, reversing switches therefor, electromagnets for operating said switches comprising magnet coils and their armatures, opposing magnet coils in position to exert a controlling influence on said electromagnets when the reversing switches are open, said opposing coils being connected permanently in circuit with the motor armature to receive the current supplied through the reversing switches to the armature, and means for establishing a local circuit through the motor armature and said opposing coils.

7. The combination of an electric motor comprising a shunt field winding, reversing switches, means associated with said switches for opening the shunt field circuit when the reversing switches are open, an electrodynamic brake circuit for the motor established by the opening of the reversing switches, and means in said circuit for holding the reversing switches open while the speed of the motor armature is above a predetermined value.

8. The combination of an electric motor comprising a shunt field winding, reversing switches, means associated with said switches for opening the shunt field circuit when the reversing switches are open, an electrodynamic brake circuit for the motor established by the opening of the reversing switches, and means wholly electric in said circuit for holding the reversing switches open while the speed of the motor armature is above a pre-determined value.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM D. LUTZ.

Witnesses:
WALTER C. STRANG,
JOHN F. RULE.